CATALOG NO.: 5000.59A
Effective Date: 3-15-99
Replaces: 3-01-98

T-3
Raypak B6000 Modbus
System Protocol Interface

T-3 Communications Interface

Raypak B6000 Boiler Controller

to Modbus Interface Card

Installation and Operating Manual

240729

TABLE OF CONTENTS

1.0 Contents (as shipped) ---- 3
2.0 Forward ---- 3
3.0 Installation and Mounting ---- 4
3.1 Dimensions and Weight ---- 4
3.2 Mechanical Installation ---- 4
3.3 Electrical Installation ---- 4
4.0 Wiring ---- 5
5.0 B6000 System Control Board ---- 6
6.0 Wiring: ---- 7
7.0 Wiring: B6000 System Control to T-3 Cable ---- 7
8.0 Check Your Power to T-3 ---- 7
9.0 Modification ---- 8
ProSoft T-3 Raypak B6000 Modbus Protocol Interface ---- 9
11.0 ProSoft T-3 Card ---- 9
11.1.0 ProSoft Product Specifications ---- 10
11.2.0 Slave Port Functionality ---- 11
11.2.1.0 MODBUS Communications ---- 11
11.2.1.1 Command/Relpy Cycle ---- 11
11.2.1.2 Command Types ---- 11
11.2.1.3 Command Error Checking ---- 11
11.2.1.4 Data Integrity ---- 12
11.2.2.0 Modbus Register Map ---- 12
11.3.0 Hardware Setup ---- 13
11.3.1.0 1500 Card Setup ---- 13
11.3.1.1 Connecting Power to the T-3 Card ---- 13
11.3.1.2 Dip Switch Configuration ---- 13
11.3.1.3 Jumper Configurations ---- 15
11.3.2.0 B6000 Communications ---- 15
11.4.0 Modbus Protocol Support ---- 16
11.4.1 Modbus Commands ---- 16
11.5.0 Diagnostics ---- 17
11.5.1 LED Indicators ---- 17
11.6.0 ProSoft Support, Service and Warranty ---- 18
11.6.1.0 Technical Support ---- 18
11.6.2.0 Service and Repair ---- 18

12.0 Raypak Limited Warranty ---- 19

APPENDICES

Appendix A
T-3 Modbus Register Map

Appendix B
Port 1 : Modbus Slave Port RS-485 Cable
Port 2 : B6000 Burner Controller RS-485 Cable

T-3 (Raypak B6000 System Protocol Interface)

Contents	Quantity
FLOPPY DISK 3.5”	1
T-3	1
EPROM (CPX.XNMn) in small black *ESD* box	1

Check packaging for damage or missing components.

I**MPORTANT NOTICE:** These instructions are intended for the use by qualified personnel only, specifically trained and experienced in the installation of this type of equipment and related system components. Installation and service personnel may be required by some states to be licensed. If your state is such, be sure your contractor bears the appropriate license. Only qualified persons shall attempt to repair this equipment. Repair must be according to these instructions.

WARNING: Improper installation, adjustment, alteration, service or maintenance may damage the equipment, create a hazard resulting in asphyxiation, explosion, fire electric shock, personal injury or property damage and will void the warranty.

CAUTION: *ONE SUPPLY SOURCE. TO REDUCE THE RISK OF ELECTRIC SHOCK, DISCONNECT ALL CONNECTIONS BEFORE SERVICING.*

CAUTION: *RISK OF ELECTRIC SHOCK, DISCONNECT SWITCH IS REQUIRED TO DE-ENERGIZE THE EQUIPMENT BEFORE SERVICING.*

Thank you for selecting the Raypak B6000 Boiler Management System and the Raypak Communication Interface. It is our sincere hope that you will enjoy its power, ease of use and energy saving features.

Please follow the instructions carefully to insure proper installation.

FORWARD

The Raypak Communication Interface is designed to allow the Communication Interface System to monitor and control the Raypak B6000 Boiler Management System.

T-3 INSTALLATION AND MOUNTING

The T-3 Module should be mounted on a permanent base not subject to vibrations, moisture or dust. It should be readily accessible, for serviceability.

DIMENSIONS AND WEIGHT

15 3/4" H	14 LBS
8" W	
5 3/4" D	

MECHANICAL INSTALLATION

Mount the System Protocol Interface within five (5) feet of B6000 System Control Box.

The Gateway enclosure must be mounted vertically with conduit holes facing downward. Conduit holes are provided to accommodate standard conduit fittings. Additional or larger conduit fittings that may be required should be located on the bottom of the module. Mount the Interface with 3/8" or 1/4" hardware in four (4) places.

A Minimum of six (6) inches clearance on all sides is required and a minimum of eighteen (18) inches clearance from the front is required for service access. The hinged side of the box is to the right and the clearance (minimum 3" from bolt hole on the right side) should be sufficient to open the cover.

A sub-panel containing the disconnect switches and surge suppressors is required at or near the equipment location(s).

For accessibility remove the lower interior panel, by removing the four (4) access screws.

INSTALL CONDUIT AS APPROPRIATE.

ELECTRICAL CHARACTERISTICS

120 VAC, 0.25A, 60 Hz

ELECTRICAL INSTALLATION

115 VAC FEEDER CIRCUITS

Install a surge protection device sized appropriately for your installation.

Install separate disconnect means for each load. Pull in appropriately sized wire for equipment as defined by NEC and/or local code. All primary wiring will be 125% of minimum or maximum rating.

It is strongly recommended that the Communications Interface, B6000 System Control Module and the B6000 Boiler Control Module be supplied from the same source power.

WIRING T-3

1. Turn off power to the B6000 System Control Box.

2. Open front door of System Protocol Interface Gateway Enclosure.

3. Remove four screws and the lower cover, revealing the field wiring blocks.

4. Attach wires from interface card to the field wiring side of left terminal block (N+, N-, GND, NC). Refer to diagram in this user manual.

5. Open front door of the B6000 System Control Box.

6. Remove four screws and the lower cover, revealing the field wiring blocks in lower left.

7. Run RS-485 cable (provided) to the lower left field wiring terminal in the B6000 System Control box. Attach wires to the upper four terminals as follows:

BLU/WHT	to	+	(1)
WHT/BLU	to	-	(2)
ORG/WHT	to	COM	(3)
SHIELD	to	GND	(4)

8. The EPROM (CPX.XNMn), in small black ESD box, must be installed in place of the current EPROM.

9. View the B6000 System Control Board picture on the next page. Note location of EPROM, U4.

10. Remove four screws holding upper panel with display screen and keypad. Carefully remove upper panel and turn over exposing B6000 System Control Board, (see next page).

11. Using ESD procedures carefully remove the EPROM from location U4.

12. Again using ESD procedures carefully install the EPROM labeled CPXXNM or CPXXM into location U4.

13. Re-assemble B6000 System Control Box.

14. Turn power on to B6000 System Control Box.

15. Connect 120 VAC (hot, Neutral, ground) to T-3 at right terminal block.

16. Re-assemble.

B6000 SYSTEM CONTROL BOARD

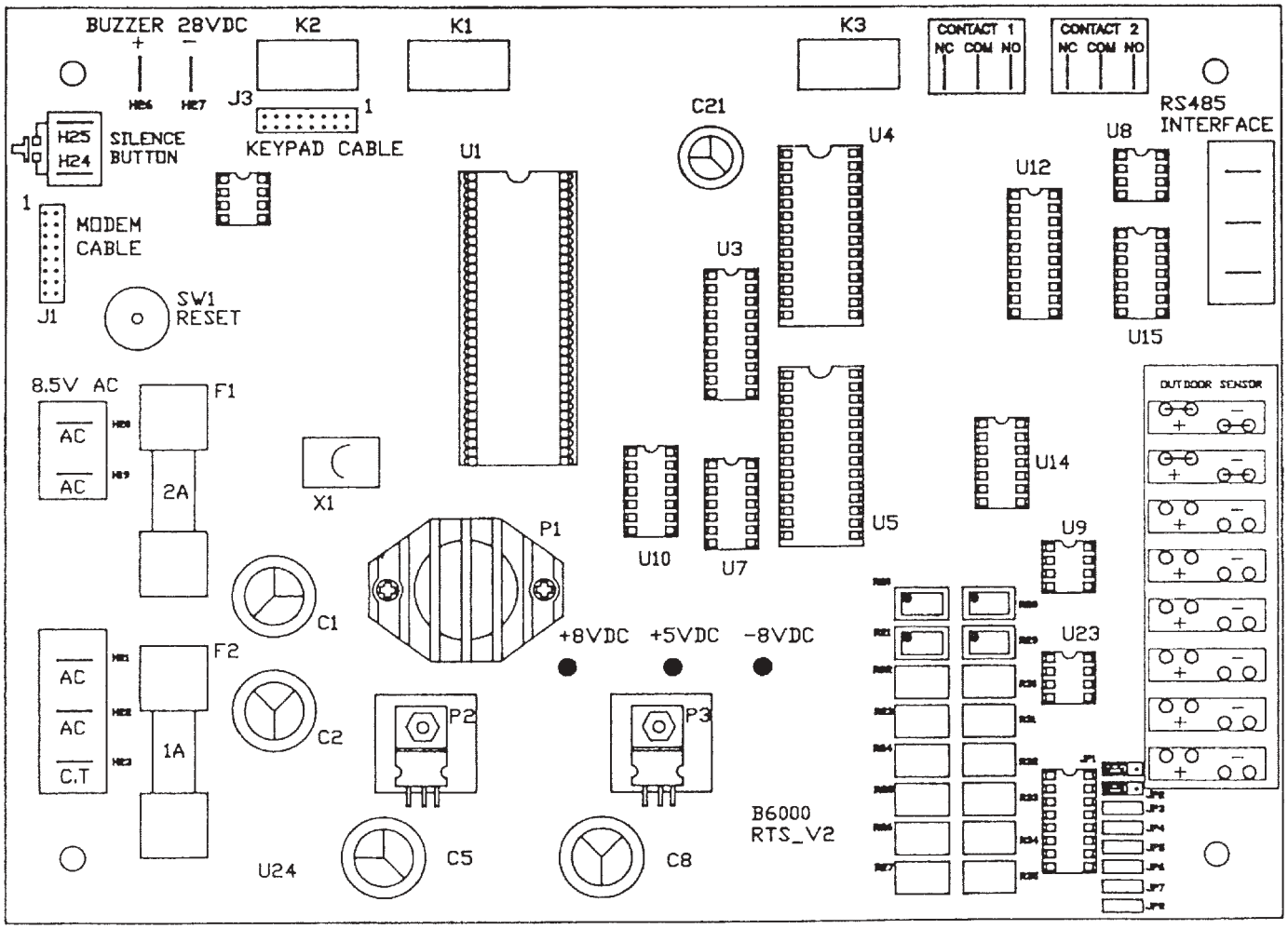
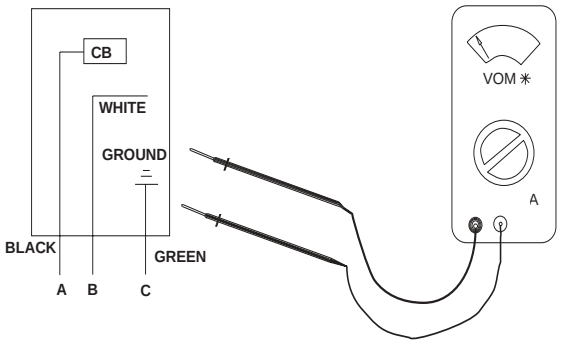


Fig. # 9460

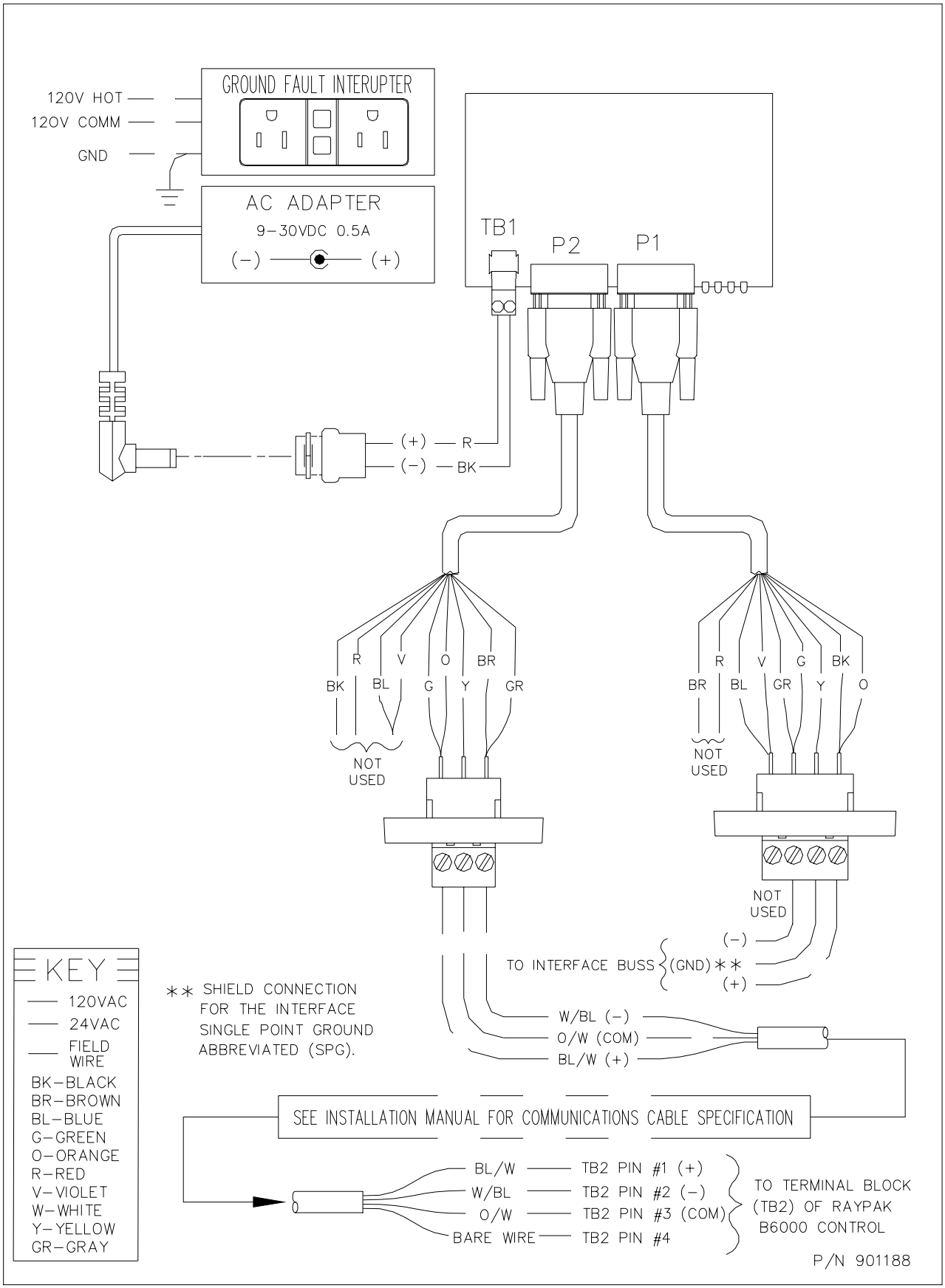
CHECK YOUR POWER SOURCE



AC = 108 Volts AC Minimum, 132 Volts MAX

AB = 108 Volts AC Minimum, 132 Volts MAX

BC = Must be less than 1.0 Volts AC


GROUND FAULT INTERUPTER
120V HOT
120V COMM
GND
AC ADAPTER
9-30VDC 0.5A
(-)
(+)
TB1
P2
P1
(+) R
(-) BK
BK R V O BR
BL G Y GR
NOT USED
BR R V G BK
BL GR Y O
NOT USED
NOT USED
(-)
TO INTERFACE BUSS (GND)**
(+)
W/BL (-)
O/W (COM)
BL/W (+)
KEY
120VAC
24VAC
FIELD WIRE
BK-BLACK
BR-BROWN
BL-BLUE
G-GREEN
O-ORANGE
R-RED
V-VIOLET
W-WHITE
Y-YELLOW
GR-GRAY
** SHIELD CONNECTION FOR THE INTERFACE SINGLE POINT GROUND ABBREVIATED (SPG).
SEE INSTALLATION MANUAL FOR COMMUNICATIONS CABLE SPECIFICATION
BL/W TB2 PIN #1 (+)
W/BL TB2 PIN #2 (-)
O/W TB2 PIN #3 (COM)
BARE WIRE TB2 PIN #4
TO TERMINAL BLOCK (TB2) OF RAYPAK B6000 CONTROL
P/N 901188

Please Read this Notice

Successful application of the T-3 card requires a reasonable working knowledge of the Raypak B6000 Boiler Control, and the application in which the combination is to be used. For this reason, it is important that those responsible for implementing the T-3 satisfy themselves that the T-3 and B6000 Boiler Control combination will meet the needs of the application.

This manual is provided to assist the user. Every attempt has been made to assure that the information provided is accurate and a true reflection of the product's installation requirements. In order to assure a complete understanding of the operation of the T-3 with B6000 Controller, the user should read all applicable Raypak documentation on the operation of the B6000.

WARNING

The T-3 card will allow remote access to commands in the B6000 Controller. The User is responsible for assuring that any applicable regulations concerning the remote operation of equipment are adhered to.

11.1. Product Specifications

The T-3 card is a hardware product designed to be the communications front end for the Raypak B6000 Boiler Control and a modbus Master Host.

The product includes the following functionality:

Modbus Slave Specifications

- Protocol Modes:
  - RTU mode with CRC-16 error checking
- Supported Modbus Function codes:
  - 2 Read Input Status
  - 3 Read Multiple Data Registers
  - 4 Read Input Registers
  - 6 Preset (Write) Single Data Register
  - 8 Loopback Test (Test 0 only)
- Supports broadcast commands from host
- RS-485 electrical interface

Raypak B6000 Interface

- RS-485 electrical interface
- Emulates Raypak Modem address and functionality

General Specifications

- Configurations via dip switches
  - Slave Address, Baud and Parity

Hardware Specifications

- 4X5” form factor
- Two male 9-pin D Shall connectors
- Communications Status lights - Active and Fault for each port
- 9 to 30 VDC external power

11.2.0 Slave Port Functionality

11.2.1 Modbus Communications

The T-3 Modbus Slave card runs the RTU version of the Modbus protocol. This capability allows the module to communicate data from a Raypak B6000 Boiler Control to a Modbus Master host, and vice-versa. The module supports both point-to-point implementation as well as multi-drop implementations.

The following discusses the functional capabilities of the T-3 card.

11.2.1.1 Command/Reply Cycle

Successful communications between the card and a host will always consist of the following two transactions:

Command: Message from master giving instruction to slave.
Reply: Response to command.

A slave station will respond to a master issued command in several ways.

Data Message: If the command was executed by the T-3 board, the response message will include the data requested, or an acknowledgement that the command was executed.

Error Message: If the command could not be executed by the T-3 board, for whatever reason, an error response message is transmitted to the master. The error response message consists of the original function code (ORed with 80hex) and error code.

No Reply: If the master does not detect a reply within its time-out period, the master should retransmit the command, before a time out error is issued. If the Slave could not decode the message or an error occurred preventing the Slave from recognizing the message, no response will be issued.

11.2.1.2 Command Types

The T-3 can respond to three types of commands from the master; read data, write data, and a diagnostic command. These are overviewed below:

Read Data: The following type of data read commands are supported:
- 2 Read Input Status
- 3 Read Multiple Registers
- 4 Read Input Registers

Write Data: The Following data write command is supported:
- 6 Single Register Write

Diagnostics: The diagnostic command is supported:
- 8 Loopback test - Code 0

11.2.1.3 Command Error Checking

When the T-3 cannot execute a command, an error code is generated and returned to the master. Error codes generated at the slave will usually be indicative of an illegal function, an illegal address, bad data, or the inability to complete a transaction because of a network problem.

11.2.1.4 Data Integrity

As in all good protocols, there must exist a level of data integrity checking to verify, with some degree of assurance, the quality of the transmitted data. The Modbus protocol supports two types of error checking:

- RTU Mode: 16 bit cyclic redundancy check (CRC-16)
- One bit parity check

CRC-16: When the master generates a message, a 16 bit CRC value is added to the end of the transmitted packet. The CRC value is generated using a series of the bit shifts and manipula tions. The receiving station executes the same calculation of the data and verifies the transmitted CRC. Any discrepancy will cause the message to be disregarded.

Parity: Parity checking can be added as an additional level of data security. If parity checking is selected, even or odd parity can be implemented.

11.2.2 Modbus Register Map

A predefined register map has been provided for the T-3 unit. This map is detailed in Appendix A.

11.3.0 Hardware Setup

11.3.1.1 1500 Interface Card Setup

11.3.1.1 Connecting Power to the T-3 Card

The T-3 Card requires an external source of DC voltage. The DC source voltage should be between 9V and 30V. The power is connected to TB1, located near the two 9 pin serial port connections.

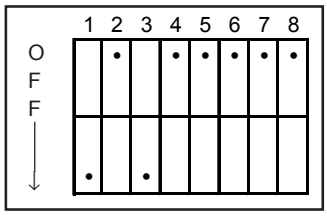
The connection to TB1 is as follows:

TB1-1	9-30 VDC (+)
TB1-2	Common (-)

11.3.1.2 Dip Switch Configuration

The T-3 card is configured primarily through two sets of dip switches. These switches are read initially on power up only. The function of the dip switches is as follows (a value of one (1) is registered when the a switch is in the ON position):

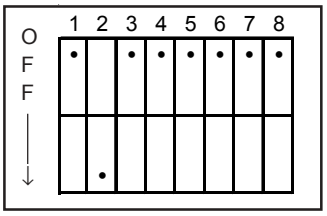
SW 1



OFF Position:

ON Position:

SW 2



OFF Position:

ON Position:

SW1 : Modbus Port Configuration

Switch Position	Function	Positions			
1	Baud Rate	3	2	1	
2	Selection	0	0	0	300
3		0	0	1	600
		0	1	0	1200
		0	1	1	2400
		1	0	0	4800
		1	0	1	**9600 - ***
		1	1	0	19200
		1	1	1	19200
4	Parity	5	4		
5	Selection	0	0		**None - ***
		0	1		Odd
		1	0		Even
		1	1		Invalid
6	Not Used				
7					
8					

*** Factory Settings**
9600, No Parity, Address Bit 1

SW2 : Modbus Slave Address Configuration

Switch Position	Function	Positions		
1	Baud Rate	1	Address Bit 0	Value = 1
2	Address	2	Address Bit 1	**Value = 2 - ***
3	Select	3	Address Bit 2	Value = 4
4		4	Address Bit 3	Value = 8
5		5	Address Bit 4	Value = 16
6		6	Address Bit 5	Value = 32
7		7	Address Bit 6	Value = 64
8		8	Address Bit 7	Value = 128

Example Addresses = 0 to 33

8	7	6	5	4	3	2	1	Address
0	0	0	0	0	0	0	0	Invalid
0	0	0	0	0	0	0	1	1 *
0	0	0	0	0	0	1	0	2
0	0	0	0	0	0	1	1	3
0	0	0	0	0	1	0	0	4
0	0	0	0	0	1	0	1	5
0	0	0	0	0	1	1	0	6
0	0	0	0	0	1	1	1	7
0	0	0	0	1	0	0	0	8
0	0	0	0	1	0	0	1	9
0	0	0	0	1	0	1	0	10
0	0	0	0	0	0	1	1	11
0	0	0	0	1	1	0	0	12
0	0	0	0	1	1	0	1	13
0	0	0	0	1	1	1	0	14
0	0	0	0	1	1	1	1	15
0	0	0	1	0	0	0	0	16
0	0	0	1	0	0	0	1	17
0	0	0	1	0	0	1	0	18
0	0	0	1	0	0	1	1	19
0	0	0	1	0	1	0	0	20
0	0	0	1	0	1	0	1	21
0	0	0	1	0	1	1	0	22
0	0	0	1	0	1	1	1	23
0	0	0	1	1	0	0	0	24
0	0	0	1	1	0	0	1	25
0	0	0	1	1	0	1	0	26
0	0	0	1	1	0	1	1	27
0	0	0	1	1	1	0	0	28
0	0	0	1	1	1	0	1	29
0	0	0	1	1	1	1	0	30
0	0	0	1	1	1	1	1	31
0	0	1	0	0	0	0	0	32
0	0	1	0	0	0	0	1	33

Example Addresses = 34 to 63

8	7	6	5	4	3	2	1	Address
0	0	1	0	0	0	1	0	34
0	0	1	0	0	0	1	1	35
0	0	1	0	0	1	0	0	36
0	0	1	0	0	1	0	1	37
0	0	1	0	0	1	1	0	38
0	0	1	0	0	1	1	1	39
0	0	1	0	1	0	0	0	40
0	0	1	0	1	0	0	1	41
0	0	1	0	1	0	1	0	42
0	0	1	0	1	0	1	1	43
0	0	1	0	1	1	0	0	44
0	0	1	0	1	1	0	1	45
0	0	1	0	1	1	1	0	46
0	0	1	0	1	1	1	1	47
0	0	1	1	0	0	0	0	48
0	0	1	1	0	0	0	1	49
0	0	1	1	0	0	1	0	50
0	0	1	1	0	0	1	1	51
0	0	1	1	0	1	0	0	52
0	0	1	1	0	1	0	1	53
0	0	1	1	0	1	1	0	54
0	0	1	1	0	1	1	1	55
0	0	1	1	1	0	0	0	56
0	0	1	1	1	0	0	1	57
0	0	1	1	1	0	1	0	58
0	0	1	1	1	0	1	1	59
0	0	1	1	1	1	0	0	60
0	0	1	1	1	1	0	1	61
0	0	1	1	1	1	1	0	62
0	0	1	1	1	1	1	1	63

* Indicates Factory Setting

The parameters are defined as follows:

Modbus Slave Address: Each of the separate drop offs of a Modbus host must have a different slave address. The slave address is selected by encoding the slave address in a binary form using the dip switches.

11.3.1.3 T-3 Jumper Configurations

The T-3 card has five sets of jumpers on the board. Generally, the default jumper positions will be adequate for most applications, with JP4 and JP5 being the only jumpers that should ever need to be reviewed. For completeness, we provide the following discussion on all the jumper locations:

Jumper	Description	Positioning	Default
JP1	Hardware Reset	Not Used	
JP2	Raypak Port Power (P2)	1-2 Non-Isolated Power 2-3 Isolated Power	1-2
JP3	Raypak Port Ground (P2)	1-2 Non-Isolated Power 2-3 Isolated Power	1-2
JP4	Modbus Port (P1) Termination Resistor	1-2 Connect 120 ohms on Rx lines (multidrop only) 2-3 Disconnect 120 ohms	2-3
JP5	Modbus Port (P1) RS-232 or RS-422/485 Select	1-2 RS-232 Select 2-3 RS-422/485 Select	2-3

11.3.2 B6000 Communications

The B6000 communications interface has been hard coded (i.e., no dip switches are required to configure this port) to operate at the following default conditions:

Baud	9600
Parity	None
Stop Bits	2

The T-3 card emulates the modem card that is normally connected to the B6000 Controller.

11.4.0 Modbus Protocol Support

11.4.1 Modbus Commands

The T-3 card supports a command subset of the Modbus Specification consisting primarily of the Function Codes required to read and write data. The following sections detail the different commands supported by the card.

Function Code	Address Command	Slave Driver Range	Comments
2	Read Input Status	10001 to 10331 & 10833	Module returns binary data from the "Input Status" register space.
3	Read Multiple Registers	40001 to 40138	The Module returns word data from the register space. The module will support up to 125 words of data in one command.
4	Read Input Registers	30001 to 30138	The module returns data from the "Input register" space in the module. The module will support up to 125 words of data in one command.
6	Single Register Write	40001 to 40030 and 40133 to 40138	This is a register write command allowing a host to change values in the B6000 unit by writing a register value.
8	Loopback Test	Test 0	This is a diagnostic command which echoes the command sent.

11.4.2 Modbus Error Codes

The T-3 card supports the following Modbus Error Codes:

Code	Name	Description
0	All OK	The module is operating as desired
1	Illegal Functions	An illegal function code request is being attempted
2	Bad Data Address	The address, or the range of addresses, covered by a request from the master are not within allowed limits.
3	Bad Data Value	The value in the data field of the command is not allowed.
4	Incomplete Response Detected	This error indicates that an incomplete response was received to a master query. Often this will indicate that the slave device may be responding too quickly or that there may be excessive noise on the line.
6	Module Busy	The module busy status code is returned when a write command from the master has not yet been completed when a second write command is received

11.5.0 Diagnostics

Several hardware diagnostics capabilities have been implemented using the LED indicator lights on the front of the T-3 card. The possible conditions as indicated by the lights are:

11.5.1 LED Indicators

Several hardware diagnostics capabilities have been implemented using the LED indicator lights on the front of the module. The possible conditions as indicated by the lights are:

Name	LED	Color	Status	Indication
Modbus (P1) ACTIVE	D1	Green	Blinking	The T-3 is receiving a command from the Modbus Host
			Steady ON or OFF	The T-3 is not detecting a valid command. If the master is transmitting, be sure all dip switches are set correctly and that the cable connection is correct.
Raypak (P2) ACTIVE	D2	Green	Blinking	The T-3 is processing a B6000 command
			Steady ON or OFF	Check cable connection to verify polarity of terminations between T-3 card and B6000 (See Appendix B)
Modbus (P1) COMM ERR	D3	Red	ON or Blinking	The Modbus port has detected a communications error condition. See Section 4.2
			OFF	No error conditions at this time.
Raypak (P2) FAULT	D4	Red	ON	The T-3 card has detected a communications error condition.
			OFF	No error conditions at this time.

Should the configuration dip switches select an invalid address or an invalid baud rate, the LED indicators will alternate in the on/off fashion on 1/2 second intervals until correct values are selected.

11.6.0 ProSoft Support, Service and Warranty

11.6.1 Technical Support

ProSoft Technology survives on its ability to provide meaningful support to its customers. Should any questions or problems arise, please feel free to contact us at:

ProSoft Technology, Inc.
9801 Camino Media
Suite 105
Bakersfield, CA 93311
(805) 664-7208
(805) 664-7233 FAX

Before calling for support, please prepare yourself for the call. In order to provide the best and quickest support possible, we will most likely ask for the following information (you may wish to fax it to us prior to calling):

1. Product Serial and Version Number
2. T-3 Configuration Information
    - Dip Switches
    - Jumpers
    - Communication cabling

11.6.2 Service and Repair

The T-3 card is an electronic product, designed and manufactured to function under somewhat adverse conditions. As with any product, through age, misapplication, or any one of many possible problems, the card may require repair.

The T-3 product has a one year parts and labor warranty according to the limits specified in the warranty. Replacement and/or returns should be directed to the distributor or Original Equipment Manufacturer from whom the product was purchased. If you need to return the card for repair, if is first necessary to obtain an RMA number from ProSoft Technology. Please call the factory for this number and display the number prominently on the outside of the shipping carton used to return the card.

LIMITED WARRANTY
T-3

SCOPE OF WARRANTY:

Raypak, Inc. ("Raypak") warrants to the original owner the T-3 to be free from defects in materials and workmanship under normal use and service for the applicable warranty period. In accordance with the terms of this Limited Warranty, RAYPAK will furnish a replacement or repair, at our option, any defective part which fails in normal use and service during the applicable warranty period. The replacement or repair will be warranted for only the unexpired portion of the original Warranty Period.

APPLICABLE WARRANTY PERIOD

The effective date of warranty coverage is the date of original installation, of the Control System, by a qualified electrician or by a RAYPAK authorized service technician. The Applicable Warranty Period is one (1) year form the effective date.

WARRANTY EXCLUSIONS

This Limited Warranty does not apply:

1. if the control system is not properly installed by a qualified technician in accordance with manufacture's installation instructions, applicable codes, ordinances and good trade practices,
2. to damage or malfunctions resulting from failure to properly install, operate or maintain the system in accordance with the manufacture's instructions;
3. if the rating plate'(s) or serial number(s) are altered, defaced or removed;
4. if the System is modified in any way or used with any non-factory authorized accessories or components;
5. to damage or failure from abuse, accident act of nature, fire, flood, freezing or the like;
6. to accessories, rubber or plastic parts, light bulbs or glass parts;
7. if the System is moved from its original installation site; or if the original owner no longer owns the site or the System.

LABOR AND SHIPPING COSTS

This Limited Warranty does not cover labor costs for service, removal or reinstallation of any part nor shipping charges to or from RAYPAK'S designated repair center or to or from the installation site. All such costs are your responsibility.

HOW TO MAKE A WARRANTY CLAIM

To make a warranty claim, promptly ship (postage prepaid) or carry the defective part to a designated RAYPAK Service Dealer or Service Station in the United States, supplying proof of purchase and date of purchase and date of installation and the model and serial numbers. If you cannot locate a dealer, contact RAYPAK'S Service Department at the address/telephone listed below. Raypak reserves the right at all times to inspect the claimed defect and verify warranty coverage at its facotry.

EXCLUSIVE WARRANTY - LIMITATION OF LIABILITY

This is the only warranty given by RAYPAK. No one is authorized to make any other warranties on Raypak's behalf. ANY IMPLIED WARRANTIES, INCLUDING MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, SHALL NOT EXTEND BEYOND THE APPLICABLE WARRANTY PERIOD SPECIFIED ABOVE. RAYPAK'S SOLE LIABILITY WITH RESPECT TO ANY DEFECT SHALL BE AS SET FORTH IN THIS LIMITED WARRANTY.. ANY CLAIMS FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES (INCLUDING DAMAGE FROM WATER LEAKAGE) ARE EXCLUDED. Some states do not allow limitations on how long an implied warranty lasts, or for the exclusion of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

THIS LIMITED WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE.

We suggest you immediately complete the information below and retain this Limited Warranty Certificate in case warranty service is needed.

RAYPAK, INC. SERVICE DEPARTMENT
31111 Agoura Road, Westlake Village, California 91361-4699
Telephone (818) 889-1500 FAX (818) 889-7314

The following information must be provided when you write or call:

Original Owner	Daytime Telephone Number
Complete Mailing Address	
City State Zip Code	Installation Site
Model Number	Contractor/Installater
Date of Installation	Serial Number

Raypak, Inc., 31111 Agoura Road, Westlake Village, CA 91361-4699 (818) 889-1500 FAX (818) 889-4522 Litho in U.S.A.

APPENDIX A

Modbus Register Map

Raypak Modbus Register Assignments

Type	2	4	3,6	Description	
		Function	Function	Function	
R/W		30001	40001	Setpoint	Day Setpoint (Desired water temp @70F)
R/W		30002	40002	Nitesetback	Night Setback (Desired water temp @ 70F)
R/W		30003	40003	Ratio Out	1-200 = 0.1 - 20.0 in 0.1 increments
R/W		30004	40004	Throttling	Delta T of all boilers in system (Normally 20 / # boilers)
R/W		30005	40005	Modulating Step (%) min 5% steps	
R/W		30006	40006	Wait State Time (Sec)	
R/W		30007	40007	Outdoor Cut off Temperature (O/C)	
R/W		30008	40008	Control Band (degrees F Tolerance from TAR) (C/B)	
R/W		30009	40009	Lead Boiler Number (1 to Number of Boilers)	
R/W		30010	40010	Number of Boilers	
R/W		30011	40011	TP - Boiler Pump Delay (Min) Boiler #1	
R/W		30012	40012	TP - Boiler Pump Delay (Min) Boiler #2	
R/W		30013	40013	TP- Boiler Pump Delay (Min) Boiler #3	
R/W		30014	40014	TP- Boiler Pump Delay (Min) Boiler #4	
R/W		30015	40015	TP- Boiler Pump Delay (Min) Boiler #5	
R/W		30016	40016	TP- Boiler Pump Delay (Min) Boiler #6	
R/W		30017	40017	TP- Boiler Pump Delay (Min) Boiler #7	
R/W		30018	40018	TP- Boiler Pump Delay (Min) Boiler #8	
R/W		30019	40019	TS - Ignition Time (Sec) Boiler #1	
R/W		30020	40020	TS - Ignition Time (Sec) Boiler #2	
R/W		30021	40021	TS - Ignition Time (Sec) Boiler #3	
R/W		30022	40022	TS - Ignition Time (Sec) Boiler #4	
R/W		30023	40023	TS - Ignition Time (Sec) Boiler #5	
R/W		30024	40024	TS - Ignition Time (Sec) Boiler #6	
R/W		30025	40025	TS - Ignition Time (Sec) Boiler #7	
R/W		30026	40026	TS - Ignition Time (Sec) Boiler #8	
R/W		30027	40027	Time - Hrs	
R/W		30028	40028	Time - Min	
R/W		30029	40029	Time - DWK	
R/W		30030	40030	Lead Change Hours	
R	10001	30031	40031	Bit 0 = Night Setback on	Night Setback
R	10017	30032	40032	Bit 0 = Fault Status)1=system fault)	Controller LED Status
R	10018			Bit 1 = Call Out Request (1 = Yes)	Controller LED Status
R		30033	40033	Outdoor Temperature + 35	
R		30034	40034	Water Temperature + 35	
R		30035	40035	Target Temperature (TAR)	
R		30036	40036	Valve Position (0-100%) - Boiler #1	
R		30037	40037	Valve Position (0-100%) - Boiler #2	
R		30038	40038	Valve Position (0-100%) - Boiler #3	
R		30039	40039	Valve Position (0-100%) - Boiler #4	
R		30040	40040	Valve Position (0-100%) - Boiler #5	
R		30041	40041	Valve Position (0-100%) - Boiler #6	
R		30042	40042	Valve Position (0-100%) - Boiler #7	
R		30043	40043	Valve Position (0-100%) - Boiler #8	
		30044	40044	Boiler #1 Status Word	**Boiler #1**
				bit	
R	10209			**0** Boiler Not On Line	(0 = Normal, 1 = Alarm)
R	10210			**1** Boiler Operation	(0 = Firing, 1 = Ready)
R	10211			**2** Low Water Cutoff	(0 = Normal, 1 = Alarm)
R	10212			**3** Low Pressure Water	(0 = Normal, 1 = Alarm)
R	10213			**4** Low Pressure Gas	(0 = Normal, 1 = Alarm)
R	10214			**5** High Pressure Gas	(0 = Normal, 1 = Alarm)

R	10215			**6**	High Limit	(0 = Normal, 1 = Alarm)
R	10216			**7**	Thermostat - Operating aquastat (not fault)	(0 = Normal, 1 = Aquastat)
R	10217			**8**	Manual Override	(0 = Normal, 1 = Alarm)
R	10218			**9**	Flow Switch	(0 = Normal, 1 = Alarm)
R	10219			**10**	No Pilot	(0 = Normal, 1 = Alarm)
		30045	40045	**bit**	Boiler #2 Status Word **Boiler #2**	
R	10225			**0**	Boiler Not On Line	(0 = Normal, 1 = Alarm)
R	10226			**1**	Boiler Operation	(0 = Firing, 1 = Ready)
R	10227			**2**	Low Water Cutoff	(0 = Normal, 1 = Alarm)
R	10228			**3**	Low Pressure Water	(0 = Normal, 1 = Alarm)
R	10229			**4**	Low Pressure Gas	(0 = Normal, 1 = Alarm)
R	10230			**5**	High Pressure Gas	(0 = Normal, 1 = Alarm)
R	10231			**6**	High Limit	(0 = Normal, 1 = Alarm)
R	10232			**7**	Thermostat - Operating aquastat (not fault)	(0 = Normal, 1 = Aquastat)
R	10233			**8**	Manual Override	(0 = Normal, 1 = Alarm)
R	10234			**9**	Flow Switch	(0 = Normal, 1 = Alarm)
R	10235			**10**	No Pilot	(0 = Normal, 1 = Alarm)
		30046	40046	**bit**	Boiler #3 Status Word **Boiler #3**	
R	10241			**0**	Boiler Not On Line	(0 = Normal, 1 = Alarm)
R	10242			**1**	Boiler Operation	(0 = Firing, 1 = Ready)
R	10243			**2**	Low Water Cutoff	(0 = Normal, 1 = Alarm)
R	10244			**3**	Low Pressure Water	(0 = Normal, 1 = Alarm)
R	10245			**4**	Low Pressure Gas	(0 = Normal, 1 = Alarm)
R	10246			**5**	High Pressure Gas	(0 = Normal, 1 = Alarm)
R	10247			**6**	High Limit	(0 = Normal, 1 = Alarm)
R	10248			**7**	Thermostat - Operating aquastat (not fault)	(0 = Normal, 1 = Aquastat)
R	10249			**8**	Manual Override	(0 = Normal, 1 = Alarm)
R	10250			**9**	Flow Switch	(0 = Normal, 1 = Alarm)
R	10251			**10**	No Pilot	(0 = Normal, 1 = Alarm)
		30047	40047	**bit**	Boiler #4 Status Word **Boiler #4**	
R	10257			**0**	Boiler Not On Line	(0 = Normal, 1 = Alarm)
R	10258			**1**	Boiler Operation	(0 = Firing, 1 = Ready)
R	10259			**2**	Low Water Cutoff	(0 = Normal, 1 = Alarm)
R	10260			**3**	Low Pressure Water	(0 = Normal, 1 = Alarm)
R	10261			**4**	Low Pressure Gas	(0 = Normal, 1 = Alarm)
R	10262			**5**	High Pressure Gas	(0 = Normal, 1 = Alarm)
R	10263			**6**	High Limit	(0 = Normal, 1 = Alarm)
R	10264			**7**	Thermostat - Operating aquastat (not fault)	(0 = Normal, 1 = Aquastat)
R	10265			**8**	Manual Override	(0 = Normal, 1 = Alarm)
R	10266			**9**	Flow Switch	(0 = Normal, 1 = Alarm)
R	10267			**10**	No Pilot	(0 = Normal, 1 = Alarm)
		30048	40048	**bit**	Boiler #3 Status Word **Boiler #5**	
R	10273			**0**	Boiler Not On Line	(0 = Normal, 1 = Alarm)
R	10274			**1**	Boiler Operation	(0 = Firing, 1 = Ready)
R	10275			**2**	Low Water Cutoff	(0 = Normal, 1 = Alarm)
R	10276			**3**	Low Pressure Water	(0 = Normal, 1 = Alarm)
R	10277			**4**	Low Pressure Gas	(0 = Normal, 1 = Alarm)
R	10278			**5**	High Pressure Gas	(0 = Normal, 1 = Alarm)
R	10279			**6**	High Limit	(0 = Normal, 1 = Alarm)
R	10280			**7**	Thermostat - Operating aquastat (not fault)	(0 = Normal, 1 = Aquastat)
R	10281			**8**	Manual Override	(0 = Normal, 1 = Alarm)
R	10282			**9**	Flow Switch	(0 = Normal, 1 = Alarm)
R	10283			**10**	No Pilot	(0 = Normal, 1 = Alarm)

		30049	40049	**bit**	Boiler #6 Status Word **Boiler #6**	
R	10289			**0**	Boiler Not On Line	(0 = Normal, 1 = Alarm)
R	10290			**1**	Boiler Operation	(0 = Firing, 1 = Ready)
R	10291			**2**	Low Water Cutoff	(0 = Normal, 1 = Alarm)
R	10292			**3**	Low Pressure Water	(0 = Normal, 1 = Alarm)
R	10293			**4**	Low Pressure Gas	(0 = Normal, 1 = Alarm)
R	10294			**5**	High Pressure Gas	(0 = Normal, 1 = Alarm)
R	10295			**6**	High Limit	(0 = Normal, 1 = Alarm)
R	10296			**7**	Thermostat - Operating aquastat (not fault)	(0 = Normal, 1 = Aquastat)
R	10297			**8**	Manual Override	(0 = Normal, 1 = Alarm)
R	10298			**9**	Flow Switch	(0 = Normal, 1 = Alarm)
R	10299			**10**	No Pilot	(0 = Normal, 1 = Alarm)
		30050	40050	**bit**	Boiler #7 Status Ward **Boiler #7**	
R	10305			**0**	Boiler Not On Line	(0 = Normal, 1 = Alarm)
R	10306			**1**	Boiler Operation	(0 = Firing, 1 = Ready)
R	10307			**2**	Low Water Cutoff	(0 = Normal, 1 = Alarm)
R	10308			**3**	Low Pressure Water	(0 = Normal, 1 = Alarm)
R	10309			**4**	Low Pressure Gas	(0 = Normal, 1 = Alarm)
R	10310			**5**	High Pressure Gas	(0 = Normal, 1 = Alarm)
R	10311			**6**	High Limit	(0 = Normal, 1 = Alarm)
R	10312			**7**	Thermostat - Operating aquastat (not fault)	(0 = Normal, 1 = Aquastat)
R	10313			**8**	Manual Override	(0 = Normal, 1 = Alarm)
R	10314			**9**	Flow Switch	(0 = Normal, 1 = Alarm)
R	10315			**10**	No Pilot	(0 = Normal, 1 = Alarm)
		30035	40051	**bit**	Boiler #3 Status Ward **Boiler #8**	
R	10321			**0**	Boiler Not On Line	(0 = Normal, 1 = Alarm)
R	10322			**1**	Boiler Operation	(0 = Firing, 1 = Ready)
R	10323			**2**	Low Water Cutoff	(0 = Normal, 1 = Alarm)
R	10324			**3**	Low Pressure Water	(0 = Normal, 1 = Alarm)
R	10325			**4**	Low Pressure Gas	(0 = Normal, 1 = Alarm)
R	10326			**5**	High Pressure Gas	(0 = Normal, 1 = Alarm)
R	10327			**6**	High Limit	(0 = Normal, 1 = Alarm)
R	10328			**7**	Thermostat - Operating aquastat (not fault)	(0 = Normal, 1 = Aquastat)
R	10329			**8**	Manual Override	(0 = Normal, 1 = Alarm)
R	10330			**9**	Flow Switch	(0 = Normal, 1 = Alarm)
R	10331			**10**	No Pilot	(0 = Normal, 1 = Alarm)

R	30052	40052	Setpoint Day Setpoint (Desired water temp @70F)
R	30053	40053	Nitesetback Night Setback (Desired water temp @ 70F)
R	30054	40054	Ratio Out 1-200 = 0.1 - 20.0 in 0.1 increments
R	30055	40055	Throttling Delta T of all boilers in system (Normally 20 / # boilers)
R	30056	40056	Modulating Step (%) min 5% steps
R	30057	40057	Wait State Time (Sec)
R	30058	40058	Outdoor Cut off Temperature (O/C)
R	30059	40059	Control Band (degrees F Tolerance from TAR) (C/B)
R	30060	40060	Lead Boiler Number (1 to Number of Boilers)
R	30061	40061	Number of Boilers
R	30062	40062	TP - Boiler Pump Delays (Min) Boiler #1
R	30063	40063	TP - Boiler Pump Delays (Min) Boiler #2
R	30064	40064	TP - Boiler Pump Delays (Min) Boiler #3
R	30065	40065	TP - Boiler Pump Delays (Min) Boiler #4
R	30066	40066	TP - Boiler Pump Delays (Min) Boiler #5
R	30067	40067	TP - Boiler Pump Delays (Min) Boiler #6
R	30068	40068	TP - Boiler Pump Delays (Min) Boiler #7
R	30069	40069	TP - Boiler Pump Delays (Min) Boiler #8

R		30070	40070	TS - Boiler Start Times (Sec) Boiler #1		
R		30071	40071	TS - Boiler Start Times (Sec) Boiler #2		
R		30072	40072	TS - Boiler Start Times (Sec) Boiler #3		
R		30073	40073	TS - Boiler Start Times (Sec) Boiler #4		
R		30074	40074	TS - Boiler Start Times (Sec) Boiler #5		
R		30075	40075	TS - Boiler Start Times (Sec) Boiler #6		
R		30076	40076	TS - Boiler Start Times (Sec) Boiler #7		
R		30077	40077	TS - Boiler Start Times (Sec) Boiler #8		
R		30078	40078	Time - Hrs		
R		30079	40079	Time - Min		
R		30080	40080	Time - DWK		
R		30081	40081	Lead Change		
R		30082	40082	Hrs Remaining		
R	10833	30083	40083	Bit 0 = Setback on (1)		
R		30084	40084	Boiler Valve Up Times (Sec)	#1	2 words per
R		30086	40086	Boiler Valve Up Times (Sec)	#2	2 words per
R		30088	40088	Boiler Valve Up Times (Sec)	#3	2 words per
R		30090	40090	Boiler Valve Up Times (Sec)	#4	2 words per
R		30092	40092	Boiler Valve Up Times (Sec)	#5	2 words per
R		30094	40094	Boiler Valve Up Times (Sec)	#6	2 words per
R		30096	40096	Boiler Valve Up Times (Sec)	#7	2 words per
R		30098	40098	Boiler Valve Up Times (Sec)	#8	2 words per
R		30100	40100	Boiler Valve Down Times (Sec)	#1	2 words per
R		30102	40102	Boiler Valve Down Times (Sec)	#2	2 words per
R		30104	40104	Boiler Valve Down Times (Sec)	#3	2 words per
R		30106	40106	Boiler Valve Down Times (Sec)	#4	2 words per
R		30108	40108	Boiler Valve Down Times (Sec)	#5	2 words per
R		30110	40110	Boiler Valve Down Times (Sec)	#6	2 words per
R		30112	40112	Boiler Valve Down Times (Sec)	#7	2 words per
R		30114	40114	Boiler Valve Down Times (Sec)	#8	2 words per
R		30116	40116	Spare		
R		30117	40117	Spare		
R		30118	40119	Spare		
R		30119	40119	Spare		
R		30120	40120	Spare		
R		30121	40121	Spare		
R		30122	40122	Spare		
R		30123	40123	O/Cdb (Off T>=C, OnT<=OC - O/Cdb)		
R		30124	40124	KPN : Proportional. Constant Numerator (0-255)		
R		30125	40125	KPD : Proportional. Constant Denominator (0-255)		
R		30126	40126	KDN : Differential. Constant Numerator (0-255)		
R		30127	40127	KDD : Differential Constant Denominator (0-255)		
R		30128	40128	Maximum Water Temp		
R		30128	40129	Maximum Water Temp Fault (0 = OK, 1 = Stpt > Max Temp, 2 = nite Stpt > Max Temp, 3 = Target > Max Temp)		
R		30130	40130	Water Sensor (0 = OK, 1 = Open, 2 = Shorted)		
R		30131	40131	Outdoor Sensor (0 = OK, 1 = Open, 2 = Shorted)		
R		30132	40132	Spare		
R/W		30133	40133	O/Cdb (Off T > = C, On T< = OC - O/Cdb)		
R/W		30134	40134	KPN : Proportional. Constant Numerator (0-255)		
R/W		30135	40135	KPD : Proportional. Constant Denominator (0-255)		
R/W		30136	40136	KDN : Differential. Constant Numerator (0-255)		
R/W		30137	40137	KDD : Differential. Constant Denominator (0-255)		
W		30138	40138	Maximum Water Temperature		

Raypak, Inc. 2151 Eastman Avenue, Oxnard, CA 93030 (805) 278-5300 • FAX (805) 278-5489
Raypak Canada Limited, 2805 Slough St., Mississauga, Ontario, CANADA L4T lG2 (905) 677- 799 9 • FAX (905) 677-8036
Litho in U.S.A.